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FOREST INSECT INVESTIGATIONS

METHODS OF ESTIMATING BARKBEETLE LOSSES

BY

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FOREST INSECT
LABORATORY

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Copy for J.C. Evenden

Palo Alto, Calif.

March 10, 1925.

Dr. F.C. Craighead,

Washington, D.C.

Dear Dr. Craighead:

I am enclosing 2 copies of a manuscript on "Methods of Estimating Barkbeetle Losses", which has been lying around for the past year. I am requesting permission to publish it in the Timberman.

Mr. Evenden has requested a copy of it and it occurred to me that it may be desirable to run this in connection with the other articles he is working up for that journal.

Very truly yours,

J.M. Miller,
Entomologist.

Enclosure.

Copy for J.C. Evenden.

METHODS OF ESTIMATING BARKBEETLE LOSSES

By - J.M. Miller.

The losses caused by forest insects differ in many respects from those occasioned by the insect pests of farm and orchard products. Forest losses do not apply to an annual or seasonal crop, but to a crop which has been many years in maturing. In the exploitation of the virgin forests of the United States, timber has been regarded as a mine rather than a crop. The areas involved in forest insect epidemics, unlike cultivated farm districts, often cover vast acreages. The forest entomologist must deal with areas of timber extending over hundreds of square miles and often must carry on his survey work in inaccessible and difficult territory.

But in the case of the more important tree killing insects, the barkbeetles, including several species of Dendroctonus, the amount of damage can be estimated with considerable accuracy, in spite of this handicap of extensive conditions. This is due to the fact that these insects instead of infesting to a constant or varying degree all trees in the forests, are concentrated only in certain trees which they attack and kill. Each dead tree represents a definite volume of what might have been potential lumber according to its breast high diameter and height. The actual number of adult beetles, eggs, larvae etc., may vary to some extent in trees of equal size, but the actual value of the loss is always fixed by the board foot volume of trees that are killed. There is no intangible loss to be considered such as might be induced by scale or aphid attack

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where the growth is checked and the tree survives in an injured or weakened condition. For these reasons it is possible not only to estimate barkbeetle losses but to actually measure them with methods of considerable accuracy.

METHODS USED IN FOREST INSECT SURVEYS:

In order to arrive at an estimates of barkbeetle losses, the forest entomologist relies upon methods which have been developed by the timber cruiser. These vary from a general guess based upon the experience of the estimator to actual mensuration of the timber consisting of the location of land lines by means of compass, the running of sample strips, and the measuring and tallying of tree diameters. The refinement of the method used varies according to the degree of accuracy desired by the party making the survey.

Methods developed in forest insect surveys in connection with barkbeetle infestations which attack several species of pine in the western United States, are based upon the technique of timber estimating as applied to the field of forest entomology. Surveys of this character are usually made with one or more of the following objects in view:

1. A general estimate of losses to inform the owner, either federal or private, of the extent to which insects are affecting his interests.

2. As a basis for formulating control plans and estimating costs of control work.

3. In order to secure data to be used as a basis for scientific studies.

Insect-killed trees are usually distinguished from the living by a direct contrast in color of the foliage. After an attack by barkbeetles the foliage of a pine tree turns to a sorrel or reddish brown color and after two or three seasons, the needles fall entirely from the tree. The "black top" stage follows and eventually the snag or "ghost tree" is the final condition of these insect-killed trees. The sorrel and red topped stages include the losses of about two seasons and the estimator can distinguish such trees with considerable certainty even at a distance. Recently infested trees sometimes retain their green foliage for a time and can only be detected by the indications of attack on the bark, such as pitchtubes and sawdust borings. The ability to distinguish dead and infested trees requires training that is essential on the part of the estimator. The method of survey used, like that of the timber estimate, varies according to the purpose for which information is desired.

One Hundred Percent Cruise:

This method consists in the layout of a definite area, locating, marking and measuring all insect killed trees that have died within a certain period. This is accomplished by locating the land lines bounding the area. With the aid of a surveyor's compass strips are run across the area often enough so that every tree of the classes to be marked is brought within a close view of the estimator. The width of strip depends upon the density of the forest type but as a rule it varies from 4 to 10 chains. The trees are blazed, numbered and mapped, the essential data being recorded on special prepared forms. The diameter breast high, height or number of logs, primary

infesting insects, stage of brood, etc., are included on this form. The work is best carried out by means of a special crew of two or three men consisting of one compassman who runs the lines and maps the trees, and one or two "spotters" who mark and number trees and record data.

This method eliminates all estimating or guess work and records as close as it is possible to do so, the actual volume of losses. The principle human factor entering into the work and the greatest source of error consists of the individual accuracy of the men who compose the crew.

The hundred per cent method is used where accuracy is essential as in special studies. It is also used on sample plots as a basis for estimates in extensive surveys which will be described later. It is used almost entirely in the marking of infested trees for treatment in control work.

This method is necessarily slow and consequently expensive. A crew of 3 men can cover at best about one half section or 320 acres per day at a cost ranging from $20.00 to $40.00 per section or from 3 to 6 cents per acre.

Extensive Survey Methods:

Quite often the information desired does not require an intensive survey and a broad estimate is just as serviceable. In this case two methods, depending upon the type of forest involved, may be used to obtain the data upon which to base estimates.

Topographic Viewing: - Where the topography is broken so that good views of the timber can be obtained, the trees that can be seen are counted

without marking. The estimator covers the area by traveling along prominent points and ridges, and from these points count the visible insect killed trees within a distance of not more than two miles. These trees are spotted on a map. Usually the trees that can be seen, counted and mapped, represent only a portion of the loss that has occurred within two or three years. This is due to the fact that a considerable number of recently killed trees will not be discovered by the cruiser, no matter how careful he may be, because of their being hidden by surrounding green trees or cut off from the range of vision by topographic depressions and ridges. In order to supplement what he has counted, an intensive or hundred percent cruise is made of carefully selected sample areas of one section or more in area. These sample plots are chosen so as to be representative of the infestation and timbered conditions on the area to be estimated. In as much as the cruiser covers his sample plot extensively first and then intensively, he at once gets a relation between the insect killed trees he is able to see by topographic viewing, and those actually existing on this sample plot. Thus he may see only 10 insect killed trees when he covers the plot extensively and finds 30 such trees when he makes the hundred percent cruise. As an estimate of the total, this ratio of 1 to 3 is then applied to the trees counted on the entire area included in the survey.

From trees marked on the sample plot, data is obtained as to average diameters, volumes and proportion of trees killed in each of the two or three years covered by the visible loss. These ratios when determined are also applied to the trees counted on the entire area. The trees on the sample plot are studied to determine the primary infesting insects, or as

may sometimes be the case, whether insects or other causes are responsible for the death of the tree.

Sample Strip Method- At times a forest type is encountered which does not permit of use of the viewing method. Density of stand and level topography may eliminate good views of an area. In this case the estimator falls back upon the sample strip. This consists of following a definite route of travel, such as road, trail or compass line, and counting all insect-killed trees within a certain distance, usually about 4 chains on each side of the line of travel. The length of the strip, multiplied by its width will amount to a definite area containing the number of trees counted. The ratio of the acreage of this strip to the acreage of the entire area to be estimated can be applied to the number of trees on the strip in order to arrive at the estimate of the total number of trees on the area. This method must also be supplemented by sample plots in order to arrive at the average diameters and volumes of the trees, the proportion of loss for each year and the primary infesting insects. Where stand and type conditions are uniform this method can be applied with considerable assurance that it will yield fairly dependable results.

Limits of the Data:

In extensive surveys various factors interfere with the accuracy of the data. Thus poor light and unfavorable topography may interfere with counting of trees. The sample plots chosen may not be representative of infestation in the area around it, and the number of trees actually studied on the sample plots may be insufficient for the accurate determination of average volumes and proper proportioning of the insect loss according to

yers. Then there is always the personal equation. An estimator may fail to do careful and thorough work or he may possess an inherent tendency to over or to under estimate. However, it has been found that regardless of these factors, the estimates obtained from an area by extensive methods do not vary more than 25% from the data obtained by an intensive or 100% cruise of the same area.

Projects Covered by Forest Insect Surveys:

By use of the extensive method just described it is possible to cover very large areas at relatively low cost. In 1917 a survey of this character was made in the Sierra Nevada Mountains of California over an acreage of 1,682,000 acres with a stand of 19 billion feet of pine timber. This survey cost about two tenths of one cent per acre and about 16 cents per million feet of timber.

On the Southern Oregon-Northern California Pine Beetle Control Project a similar survey has been made annually on an area of 1,276,000 acres as a basis for control plans. This survey which includes a detailed cruise of about 8% of the entire area costs on the average of about three mills per acre.

Northfork, California,

May 15, 1924. J.M. Miller.